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(54) Title: ABSORBENT COMPOSITE MATERIALS <div data-bbox="643 1110 878 1320"></div> (57) Abstract <p>An absorbent composite material composed of a fibrous absorbent material (11) and a binding agent (10), the binding agent (10) binding at least a portion of the fibers of the fibrous absorbent material (11). The fibrous absorbent material is preferably selected from the group consisting of fluff pulp, synthetic fibers, natural fibers, and combinations thereof. The material suitable for use as an absorbent in personal care absorbent articles such as diapers, training pants, and adult incontinence garments.</p>		

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ABSORBENT COMPOSITE MATERIALS

BACKGROUND OF THE INVENTION

This invention relates to an absorbent composite material which is particularly suitable for use in diapers, training pants, adult incontinence products, and the like. The absorbent composite material of this invention provides absorbent cores for such personal care absorbent articles having improved integrity, resistance to wet collapse, shape retention, and uptake rate. In addition, the material serves as a controlled rate retention material, exhibiting a controlled release swelling mechanism which is particularly suitable for diapers and other such personal care absorbent articles.

DESCRIPTION OF PRIOR ART

Disposable absorbent articles such as diapers, training pants, adult incontinence garments, and the like have been known for some time. These products include an absorbent material which is used to absorb and hold or contain body fluids. Initially, in many of these products, the absorbent material comprised what is termed "wadding" or plies of tissue. The wadding was disposed between a liquid-impermeable backing and a liquid-permeable facing and the plies of tissue were used to absorb and contain the liquid within the product.

Products using wadding-type absorbent materials were replaced, for the most part, by an improved absorbent material comprising "fluffed wood pulp fibers". This absorbent material comprises a layer of individualized wood pulp fibers, with the layer having substantial thickness. This material provided personal care articles with the improved absorbent capacity and somewhat better containment than personal care articles using the wadding-type material. In addition, the fluffed wood pulp layer is quite soft, flexible, and conformable and, thus, produces an improved personal care article over personal care articles using wadding as the absorbent layer.

Although fluffed wood pulp absorbent materials provide improved capacity, the efficiency with which the capacity is used in personal care articles such as diapers is poor. This is due, in part, to the fact that the fluffed wood pulp absorbent material tends to break apart upon flexing and that once the absorbent material has accepted a substantial amount of liquid, the cellulosic fibers tend to collapse, sometimes causing liquid to be squeezed from the product and to leak. In addition, the fluid to be absorbed is generally deposited in a localized area and the ability of the fluid to move along the plane of the material is poor. U.S. Patent

4,560,372 discloses an absorbent material of a layered structure for addressing these issues, the layered structure comprising a first fibrous layer substantially of resilient fibers and containing at least about 10% by weight of a superabsorbent material and a second layer of hydrophilic porous material substantially co-extensive with the first layer and superposed on the first layer.

Superabsorbents are polymers that are able to absorb fluid in quantities corresponding to many times their weight. They are also able to retain the absorbed fluid, even when subjected to external pressure. Such polymers have found wide use in absorbent personal care products such as diapers, sanitary pads and the like. These polymers are normally in particle form, such as in the form of grains, granules, flakes or fibers, and are typically layered or mixed with other absorbent materials, for example cellulose fibers.

The effectiveness of such superabsorbents in an absorbent material is contingent upon many factors including where and how the superabsorbent is incorporated into the absorbent material, its particle form and physical and chemical properties, and also the speed at which it absorbs fluids, its gel strength and its ability to retain absorbed fluids. One problem negatively affecting the absorbency of the absorbent material containing superabsorbents is that the superabsorbent particles located in a wetting region of the absorbent material bind the fluid in this region upon the first insult, thereby reducing the effectiveness of the material to absorb subsequent insults. As a result, the total absorption capacity of the absorbent body is not utilized to an optimal extent, thereby increasing the risk of fluid leakage from the article. This problem is even more acute where the articles are intended to be worn for extended periods of time, such as through the night during which wetting often occurs on several occasions.

Fluid distribution and material utilization are two critical performance measures for absorbent products such as diapers. It has been observed that the majority of soiled diapers exhibit uneven fluid distribution. Typically, the back portion of the diaper contains little or no absorbed fluid compared to the front/target area. As a result, there is severe under utilization of the absorbent material due to this inefficient fluid handling.

The movement of fluid away from the target zones requires the presence of two key functionalities - 1) fluid handling or "distribution" throughout the entire product length and width and 2) "slow absorption" retention material located in the target zone. The advantages of using delayed absorption superabsorbent materials in diapers is taught, for

example, by British Patent Application GB-2-280-115-A. A slow absorbing retention material has the potential for higher absorbency rates while reducing product performance deterioration typically associated with later insults.

SUMMARY OF THE INVENTION

The Absorbency Time Index of a material is defined as:

$$\text{Absorption Time Index} = (t_{20} + t_{40} + t_{60} + t_{80})/4$$

where t_i is the time it takes for the material saturation to reach $i\%$ of the final (200 minute) value. Known superabsorbents such as Stockhausen Favor 836 and Stockhausen Favor 870, available from Stockhausen in Greensboro, N.C., and Dow Dry Tech 2035, available from Dow have very fast Absorption Time Indexes in the range of about 2.7 to about 4.0 minutes.

It is an object of this invention to provide an absorbent composite material suitable for use in personal care absorbent products, such as diapers, training pants, adult incontinence garments, and the like, having improved integrity, resistance to wet collapse, shape retention, and uptake rate.

It is another object of this invention to provide an absorbent composite material having the capability of serving as a controlled rate retention material.

It is yet another object of this invention to provide an absorbent composite material having the capability of slowing down the absorption rate of superabsorbents which normally have inherently high absorption rates.

These and other objects of this invention are achieved by an absorbent composite material having an Absorption Time Index greater than about 10 minutes comprising a fibrous absorbent material selected from the group consisting of fluff pulp, synthetic fibers, natural fibers, and combinations thereof, a superabsorbent material having a superabsorbent Absorption Time Index of less than about 5 minutes, and a binding agent, the binding agent binding at least a portion of the fibers of the fibrous absorbent material. The fibrous absorbent material comprises in the range of about 10% to about 90% by weight of the absorbent composite material and the superabsorbent material comprises in the range of about 10% to about 90% by weight of the absorbent composite material. The binding agent is preferably a tacky adhesive or tacky polymeric fibers.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and features of this invention will be better understood from the following detailed description taken in conjunction with the drawings wherein:

Fig. 1 is a cross sectional view of a homogeneous absorbent composite material in accordance with one embodiment of this invention;

Fig. 2 is a cross sectional view of a layered absorbent composite material in accordance with one embodiment of this invention;

Fig. 3 is a cross sectional view of a homogeneous absorbent composite material comprising particulate superabsorbent materials;

Fig. 4 is a cross sectional view of a homogeneous absorbent composite material comprising fibrous superabsorbent materials in accordance with one embodiment of this invention;

Fig. 5 is a cross sectional view of an absorbent composite material wherein the superabsorbent material is not uniformly distributed therethrough;

Fig. 6 is a diagram showing the effect of adhesive levels and embossing patterns on the fluid uptake of the absorbent composite material of this invention;

Fig. 7 is a diagram showing the effect of various thermal/pressure treatments on fluid uptake by the absorbent composite material of this invention;

Fig. 8 is a diagram showing the effect of composite uptake rate on fluid distribution and material utilization for a typical homogeneous structure; and

Fig. 9 shows the effect of composite uptake rate on fluid distribution and material utilization for an absorbent composite material in accordance with this invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Methods for determining the Absorption Time Index of a material vary depending upon the material being tested. The absorbent composite material of this invention was tested in accordance with the following procedure. A funnel fitted with a 15 micron average pore size fritted glass plate (e.g. Pyrex No. 36060 Buchner funnel with fritted disk) is connected to a 0.9% NaCl saline reservoir, which is sitting on a balance. The balance is connected to a data processing device so that the amount of liquid in the reservoir can be recorded as a function of time. A 504 gram brass disk having a diameter of 2.75 inches is used to apply a 0.2 psi pressure to the sample, a composite material disk also having a diameter of 2.75 inches. The height of the funnel is adjusted so that the upper surface of the fritted glass disk is the same height as the liquid surface in the reservoir. The data processing device is started so as to read the output of the balance. A sample to be tested, together with the plastic disk, is placed on the fritted glass disk. The absorption of liquid by the sample is then

measured for 200 minutes. Analysis of the data involves plotting of the ratio of absorption in grams to the final absorption in grams as a function of time to obtain a curve from which the Absorption Time Index can be determined.

For determining the Absorption Time Index for superabsorbent, a somewhat different method is employed due to the different physical and chemical characteristics of the superabsorbent. In this case, the sample holder comprises a cylindrical tube of about 1.5 inches high having a 1-inch inside diameter. A 100 mesh stainless steel screen is attached to the bottom of the tube. A plastic container serves as a sample holder receiver and is connected to a 0.9% saline reservoir, which is sitting on a balance connected to a data processing device. A 3.3 gram plastic disk having a diameter of 0.95 inches is used to apply a pressure of 0.01 psi to the sample. In this case, the sample is 0.160 grams of superabsorbent material. The height of the sample holder receiver is adjusted so that its bottom is at the same height as the liquid surface in the reservoir. The data processing device which processes the output from the balance is started and the sample, together with the plastic disk, is placed on the sample holder receiver. In this case, absorption of fluid by the sample is measured for 60 minutes, after which the data is processed as before.

The material of this invention provides improved absorbent composites that are particularly suitable for use in personal care absorbent articles, such as baby diapers, training pants, adult incontinence products, and the like. The absorbent composite material of this invention utilizes a tacky adhesive and/or tacky polymeric fibers to bind fluff pulp and various synthetic and natural fibers, for example cellulose acetate, rayons, polypropylene, etc. to produce absorbent cores having improved integrity, resistance to wet collapse, shape retention and uptake rate for use in the aforementioned personal care absorbent products. In accordance with a particularly preferred embodiment of this invention, the absorbent composite material also comprises a superabsorbent material. Various synthetic and natural fibers used in the material of this invention may be selected to enhance liquid distribution.

The superabsorbent/fluff absorbent composites in conventional personal care absorbent articles such as diapers tend to collapse when wet, resulting in reduced absorbent uptake rate, integrity and poor shape retention. As a result, the potential for product leakage arising from multiple insults is increased. In addition, these absorbent core materials are inefficient due to the relatively low amount of liquid absorbed per gram of absorbent. Consequently, they have limited ability to distribute liquid away from the target zone.

The concentration of liquid around the insult target area causes the product to bulge and sag due to the weight of the liquid. In addition, once the limited capacity of the target area is reached, there is further increased potential for product leakage. Furthermore, the heavily saturated absorbent material in contact with the skin may cause skin irritation. Finally, wet and dry superabsorbent material particles often migrate from these conventional superabsorbent material/fluff absorbent cores and become attached to the skin of the wearer of the absorbent article. The material of this invention which addresses these problems is an absorbent composite material having an Absorption Time Index greater than about 10 minutes comprising a fibrous absorbent material selected from the group consisting of fluff pulp, synthetic fibers, natural fibers, and combinations thereof, a superabsorbent material having a superabsorbent Absorption Time Index of less than about 5 minutes, and a binding agent, wherein the binding agent binds at least a portion of the fibers of the fibrous absorbent material. In accordance with a preferred embodiment, the Absorption Time of the absorbent composite material of this invention Index Vis in the range of about 10 minutes to 120 minutes and most preferably is in the range of about 15 minutes to about 60 minutes. The basic weight of the absorbent composite material of this invention is in the range of about 100 g/m² to about 1000 g/m². In accordance with one preferred embodiment of this invention, the fibrous absorbent material is pulp fibers. The fibrous absorbent material comprises preferably in the range of about 10% to about 90% by weight of said absorbent composite material, more preferably about 20% to about 80% by weight of said absorbent composite material, and most preferably about 30% to about 60% by weight of said composite material. Said superabsorbent material preferably comprises about 10% to 90%, more preferably about 20% to about 80%, and most preferably about 40% to about 70% by weight of said absorbent composite material. The binding agent is preferably a tacky adhesive or tacky polymeric fibers which bond with the non-tacky fibrous absorbent materials used in personal care absorbent articles. In accordance with one preferred embodiment of this invention, the absorbent composite material comprises a substantially homogeneous absorbent web of about 0.05% to about 5% by weight of a tacky adhesive and/or tacky polymeric fibers blended with, and substantially bonded to, non-tacky fibrous absorbent materials such as fluff pulp, cellulose acetate, rayons, staple fibers, and the like. Fig. 1 shows a homogeneous absorbent composite material in accordance with one embodiment of this invention comprising tacky polymeric fibers 10 bonded to non-tacky fibers 11.

The superabsorbent materials may be in the form of particles 16 as shown in Fig. 3 or in the form of fibers 17 of various physical and functional absorption properties, as shown in Fig. 4. In addition, as shown in Fig. 5, the superabsorbent material, in accordance with one embodiment of this invention, is incorporated into the absorbent composite material in a non-uniform fashion resulting in some regions of the absorbent composite material having no superabsorbent material, some regions of the absorbent composite material having low concentrations of superabsorbent material, and some regions of the absorbent composite material having high concentrations of superabsorbent material.

In accordance with one preferred embodiment of this invention, the absorbent composite material comprises a plurality of layers as shown in Fig. 2. In accordance with the embodiment shown in Fig. 2, the fibrous absorbent material forms a lower density layer 12, a higher density layer 14, and an intermediate bonding agent layer 13. In accordance with a particularly preferred embodiment of this invention, the lower density layer has a density of less than about 0.06 g/cc and a basis weight in the range of about 50 g/m² to about 200 g/m². The higher density layer has a density greater than about 0.08 g/cc, preferably in the range of about 0.08 g/cc to about 1.5 g/cc. The lower density layer 12 and the higher density layer 14, as shown in Fig. 2, are lined in the vertical direction and bonded together by a layer of tacky adhesive and/or polymeric fibers 13 disposed therebetween. In accordance with this embodiment, some of the tacky fibers are embedded into the lower and higher density layers to provide an integrated absorbent composite having reduced potential for interfacial separation between the layers, thereby providing enhanced absorbent performance.

The tacky adhesive and/or tacky polymeric fibers bind the absorbent composite material structure together to enhance absorbent integrity and shape retention. In addition, through a proper selection of tacky adhesive and polymeric fibers, along with the non-tacky component, for example curly cellulose, absorbent composites with enhanced uptake rate may be produced. We have found, for example, that an absorbent composite material in accordance with one embodiment of this invention comprising up to 5% by weight hot melt adhesive, 35% by weight superabsorbent, and 60 - 65% by weight absorbent fluff pulp had an improved integrity in the range of 109 - 678% compared to superabsorbent/fluff absorbent composite materials without tacky adhesives.

As previously stated, the absorbent composite material of this invention functions as a controlled rate retention material. The structure and materials comprising the

absorbent composite material of this invention exhibit a controlled release swelling mechanism which is suitable for use in diapers and other personal care absorbent products. The absorbent composite material may be embossed to further favorably influence integrity and fluid uptake rate. In accordance with one particularly preferred embodiment, the absorbent composite material of this invention has an embossed area, defined as the total percentage of area that has been compressed by the embossing pattern, of less than about 50%.

To create personal care absorbent products such as diapers having desired liquid handling, retention materials exhibiting the desired fluid uptake rates are required. In certain designs, slow retention materials are a necessity. The absorbent composite material of this invention provides a new class of retention composites which can be engineered to achieve desired fluid uptake rates. The absorbent composite material of this invention uses conventional materials to achieve a thin and efficient structure having better fit, desired uptake rate, excellent integrity, and controlled fluid placement. Additionally unique features of the absorbent composite material of this invention include a comfortably soft feel during wear and a cut-and-place option for diaper processing. The absorbent composite material of this invention also has the advantage of controlling uptake rates without the need for low permeability wrap materials.

By controlling the various components comprising the absorbent composite material of this invention and their structure, the controlled release swelling mechanism of the material can also be influenced. Factors affecting this mechanism include:

- 1) Absorbent filling - superabsorbent, fluff, and adhesive types;
- 2) Bonding agent - adhesive bonding agents versus synthetic fibers;
- 3) Embossing type, pattern and coverage; and
- 4) Basis weight - ratio of superabsorbent/fluff/adhesive.

These elements can be varied to produce an absorbent composite material in accordance with this invention having a range of absorbency mechanisms from immediate to delayed fluid absorption. The absorbent composite material of this invention provides the greater fluid distribution and material utilization needed for personal care absorbent products. Furthermore, data show that the superabsorbent, fluff and adhesive drastically affect the materials fluid absorption rate.

EXAMPLE I

In this example, commercial superabsorbent, fluff, and adhesive were used to construct absorbent composite material structures in accordance with this invention. These raw materials included Stockhausen Favor 870M from Stockhausen, Greensboro, North Carolina.; CR1654 Pulp from Kimberly-Clark Corporation, Neenah, Wisconsin; and National Starch Hot Melt Adhesive 5541 from National Starch, Bridgewater, New Jersey. Other suitable adhesives also from National Starch include Grades 3456, 70-3998 and 33-2858. Both homogeneous and layered absorbent composite structures were made. These composites had superabsorbent levels in the range of about 30% to 60 % by weight and fluff levels from about 40% to about 70 % by weight. In addition, all of the composites had add-on levels of hot melt adhesive ranging from about 5% to about 20% by weight. Some of the composites were further embossed with patterns so as to impact rate behaviors.

Fig. 6 shows the effect of adhesive levels and embossing patterns on the fluid pickup of the absorbent composite materials. Data lines designated as Codes 1, 2 and 3 correspond to absorbent composite materials which were not embossed whereas data lines designated by Codes 4, 5 and 6 correspond to absorbent composite materials which were thermally embossed with a grid-like pattern wherein line width was approximately 1/32 inch, line spacing was about 1/4 inch and embossed area was about 22%. The data show that higher adhesive levels and thermal embossing tend to reduce the absorbency rate of the composite material.

EXAMPLE II

To determine the effect of composition, homogeneity, and thermal/pressure treatment on the absorbency properties of the absorbent composite material of this invention, samples having superabsorbent/fluff ratios in the range of 30/70 to 60/40 with hot melt adhesive add-on levels ranging from 10 to 20% by weight were prepared. Samples having higher adhesive levels, higher fluff content, and lower superabsorbent levels were found to have slower uptake rates. Overall, the effect of adhesive on uptake rates was found to be more dramatic than that of superabsorbent or fluff. By comparison of uniform absorbent composite materials wherein adhesive is uniformly distributed therethrough and layered absorbent composite materials in which adhesive is disposed between the layers of fibrous absorbent material, we found that the homogeneous/uniform embodiment provided a slower uptake rate than the layered embodiment.

In order to determine the effect of thermal/pressure treatment on the absorbent composite material of this invention, four treatment methods were employed as follows:

- 1) No treatment;
- 2) Thermal/pressure embossed grid pattern;
- 3) Thermal/pressure embossed point pattern;
- 4) Thermal/pressure embossed flat pattern.

The point and grid patterns created a quilt/pocketed surface. In the simulated forced flow condition of the test procedure, the composites were under a pressure of 0.3 psi while exposed to excess saline. After 90 minutes, all of the samples had reached similar capacity, albeit at different rates. These results are shown in Fig. 7. During the course of these tests, we noted that the point pattern (less pronounced quilted pockets) made up of 1/32" x 1/32" point sizes, with a 1/4-inch distance between neighboring points and an embossed area of 1.2% was less effective than the grid pattern in reducing the fluid pick up rate, but more effective than the flat pressed pattern.

A slow absorbent composite material has the potential for providing higher absorbency rates for later insults and compensate for product performance deterioration typically associated with later insults. Figs. 8 and 9 show the effect of composite uptake rate on fluid distribution and material utilization. As shown, the absorbent composite materials were divided into 3 zones, low, medium, and high heights. The absorbency rates of each zone were varied to control fluid placement. Fig. 7 shows that a typical homogeneous structure containing superabsorbent and fluff, in which all of the zones have fast fluid uptake rates, achieves a non-uniform fill and does not utilize the entire product. By comparison, Fig. 8 shows an absorbent composite material structure having uniform fill and material utilization. We found that the absorbent composite materials of this invention were most efficient when composed of the following zones:

- 1) Slow uptake rate, low height zone;
- 2) Moderate uptake rate, medium height zone; and
- 3) Fast uptake rate, and high height zone.

Thus, it is apparent that when the variables are appropriately selected and balanced, the absorbent composite material of this invention provides the greater fluid distribution and material utilization necessary for personal care absorbent products through its controlled swelling mechanism.

While in the foregoing specification this invention has been described in relation to certain preferred embodiments thereof, and many details have been set forth for purpose of illustration, it will be apparent to those skilled in the art that the invention is susceptible to additional embodiments and that certain of the details described herein can be varied considerably without departing from the basic principles of the invention.

WE CLAIM:

1. An absorbent composite material comprising:
 - a fibrous absorbent material selected from the group consisting of fluff pulp, synthetic fibers, natural fibers, and combinations thereof;
 - a superabsorbent material having a Superabsorbent Absorption Time Index of less than about 5 minutes; and
 - a binding agent, said binding agent binding at least a portion of the fibers of said fibrous absorbent material;said absorbent composite material having an Absorption Time Index greater than about 10 minutes.
2. An absorbent composite material in accordance with Claim 1, wherein said fibrous absorbent material comprises in a range of about 10% to about 90% of said absorbent composite material.
3. An absorbent composite material in accordance with Claim 1, wherein said fibrous absorbent material comprises in a range of about 20% to about 80% of said absorbent composite material.
4. An absorbent composite material in accordance with Claim 1, wherein said fibrous absorbent material comprises in a range of about 30% to about 60% of said absorbent composite material.
5. An absorbent composite material in accordance with Claim 1, wherein said superabsorbent material comprises in a range of about 10% to about 90% by weight of said absorbent composite material.
6. An absorbent composite material in accordance with Claim 1, wherein said superabsorbent material comprises in a range of about 20% to about 80% by weight of said absorbent composite material.

7. An absorbent composite material in accordance with Claim 1, wherein said superabsorbent material comprises in a range of about 40% to about 70% by weight of said absorbent composite material.
8. An absorbent composite material in accordance with Claim 1, wherein said fibrous absorbent material is pulp fibers.
9. An absorbent composite material in accordance with Claim 1, wherein said binding agent comprises a tacky adhesive.
10. An absorbent composite material in accordance with Claim 1, wherein said binding agent comprises a plurality of tacky polymeric fibers.
11. An absorbent composite material in accordance with Claim 1, wherein a basis weight of said material is in a range of about 100 g/m² to about 1000 g/m².
12. An absorbent composite material in accordance with Claim 1, wherein said Absorption Time Index is in a range of about 10 minutes to about 120 minutes.
13. An absorbent composite material in accordance with Claim 1, wherein said Absorption Time Index is in a range of about 15 minutes to about 60 minutes.
14. An absorbent composite material in accordance with Claim 1, wherein said fibrous absorbent material is formed as a lower density layer having a lower density layer basis weight in a first range of about 50g/m² to about 200g/m² and a higher density layer having a higher density layer basis weight in a second range of about 100g/m² to about 500g/m², said lower density layer and said higher density layer aligned in a vertical direction and bonded together by said binding agent.
15. An absorbent composite material in accordance with Claim 1 comprising in a range of about 0.5% to about 50% by weight of an adhesive said binding agent.

16. An absorbent composite material in accordance with Claim 1, wherein said at least one superabsorbent material is in particulate form.

17. An absorbent composite material in accordance with Claim 1, wherein said at least one superabsorbent material is in a fibrous form.

18. An absorbent composite material in accordance with Claim 1, wherein said at least one superabsorbent material is uniformly distributed throughout said absorbent composite material.

19. An absorbent composite material in accordance with Claim 1, wherein said at least one superabsorbent material is distributed nonuniformly within said absorbent composite material.

20. An absorbent composite material in accordance with Claim 19, wherein said at least one superabsorbent material is nonuniformly distributed in a lateral plane throughout said absorbent composite material.

21. An absorbent composite material in accordance with Claim 19, wherein said at least one superabsorbent material is nonuniformly distributed in a z-direction throughout said absorbent composite material.

22. An absorbent composite material in accordance with Claim 1 further comprising at least one embossed pattern covering an embossed area in a range of about 0% to about 50%.

23. An absorbent composite material in accordance with Claim 1, wherein said binding agent is uniformly distributed throughout said fibrous absorbent material.

24. A personal care absorbent article comprising:
an absorbent composite material having an Absorption Time Index greater than about 10 minutes and comprising a fibrous absorbent material selected from the group consisting of fluff pulp, synthetic fibers, natural fibers, and combinations thereof, a superabsorbent material having a Superabsorbent Absorption Time Index of less than about 5 minutes, and a binding agent, said binding agent binding at least a portion of the fibers of said fibrous absorbent material.
25. A personal care absorbent article in accordance with Claim 24, wherein said fibrous absorbent material comprises in a range of about 10% to about 90% of said absorbent composite material.
26. A personal care absorbent article in accordance with Claim 24, wherein said superabsorbent material comprises in a range of about 10% to about 90% by weight of said absorbent composite material.
27. A personal care absorbent article in accordance with Claim 24, wherein said fibrous absorbent material is pulp fibers.
28. A personal care absorbent article in accordance with Claim 24, wherein said binding agent comprises a tacky adhesive.
29. A personal care absorbent article in accordance with Claim 24, wherein said binding agent comprises a plurality of tacky polymeric fibers.
30. A personal care absorbent article in accordance with Claim 24, wherein a basis weight of said material is in a range of about 100 g/m² to about 1000 g/m².
31. A personal care absorbent article in accordance with Claim 24, wherein said Absorption Time Index is in a range of about 10 minutes to about 120 minutes.

32. A personal care absorbent article in accordance with Claim 24, wherein said Absorption Time Index is in a range of about 15 minutes to about 60 minutes.

33. A personal care absorbent article in accordance with Claim 24, wherein said fibrous absorbent material is formed as a lower density layer having a lower density layer basis weight in a first range of about 50 g/m² to about 200 g/m² and a higher density layer having a higher density layer basis weight in a second range of about 100 g/m² to about 500 g/m², said lower density layer and said higher density layer aligned in a vertical direction and bonded together by said binding agent.

34. A personal care absorbent article in accordance with Claim 24 comprising in a range of about 0.5% to about 50% by weight of an adhesive said binding agent.

35. A personal care absorbent article in accordance with Claim 24, wherein said at least one superabsorbent material is uniformly distributed throughout said absorbent composite material.

36. A personal care absorbent article in accordance with Claim 24, wherein said at least one superabsorbent material is distributed nonuniformly within said absorbent composite material.

37. A personal care absorbent article in accordance with Claim 24 further comprising at least one embossed pattern covering an embossed area in a range of about 0% to about 50%.

38. A diaper comprising:

an absorbent composite material having an Absorption Time Index greater than about 10 minutes and comprising a fibrous absorbent material selected from the group consisting of fluff pulp, synthetic fibers, natural fibers, and combinations thereof, a superabsorbent material having a Superabsorbent Absorption Time Index of less than about 5 minutes, and a binding agent, said binding agent binding at least a portion of the fibers of said fibrous absorbent material.

39. A diaper in accordance with Claim 38, wherein said binding agent comprises at least one of a tacky adhesive and tacky polymeric fibers.

40. A diaper in accordance with Claim 38, wherein said fibrous absorbent material comprises in a range of about 10% to about 90% of said absorbent composite material.

41. A diaper in accordance with Claim 38, wherein said superabsorbent material comprises in a range of about 10% to about 90% by weight of said absorbent composite material.

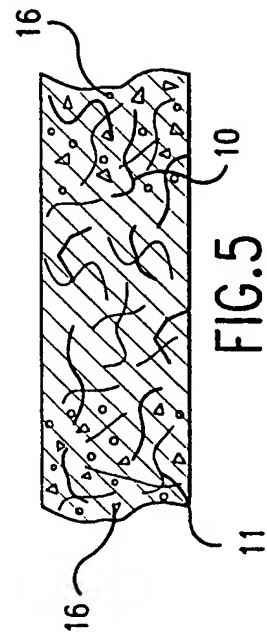
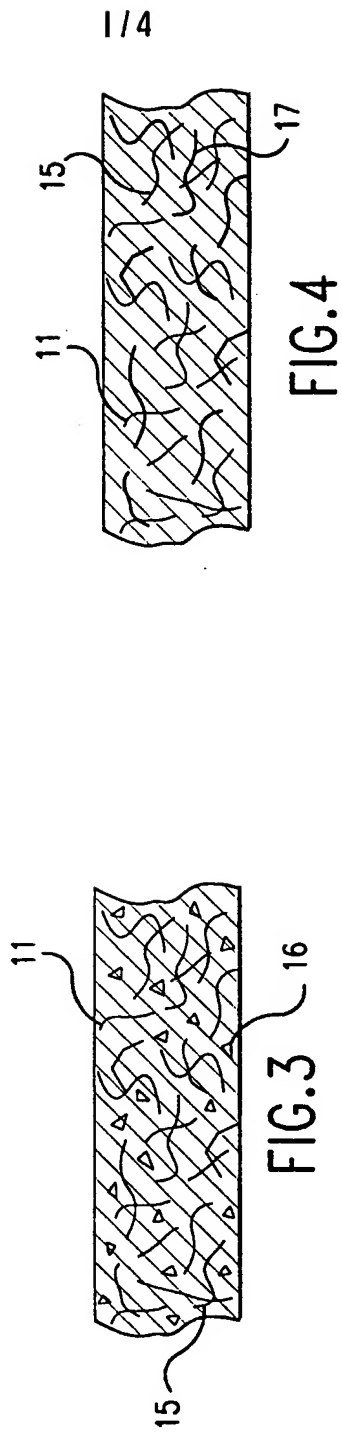
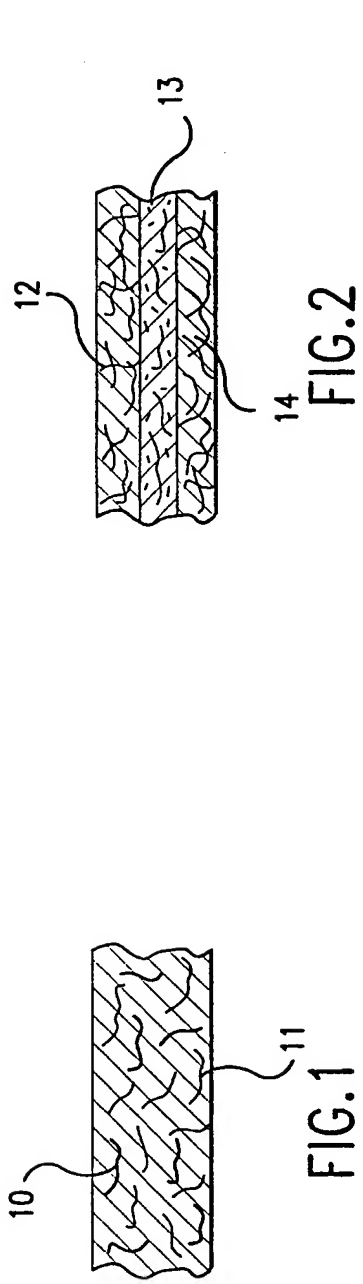
42. A diaper in accordance with Claim 38, wherein a basis weight of said material is in a range of about 100 g/m² to about 1000 g/m².

43. A diaper in accordance with Claim 38, wherein said fibrous absorbent material is pulp fibers.

44. A diaper in accordance with Claim 38 further comprising in a range of about 0.5% to about 50% by weight of an adhesive said binding agent.

45. A diaper in accordance with Claim 38, wherein said fibrous absorbent material is formed as a lower density layer having a lower density layer basis weight in a first range of about 50 g/m² to about 200 g/m² and a higher density layer having a higher density layer basis weight in a second range of about 100 g/m² to about 500 g/m², said lower density layer and said higher density layer aligned in a vertical direction and bonded together by said binding agent.

46. A diaper in accordance with Claim 38, wherein said absorbent composite material comprises in a range of about 0.5% to about 50% by weight of an adhesive said binding agent, about 30 to about 70% by weight of said at least one superabsorbent material, and about 30 to about 60% by weight of said fluff pulp.



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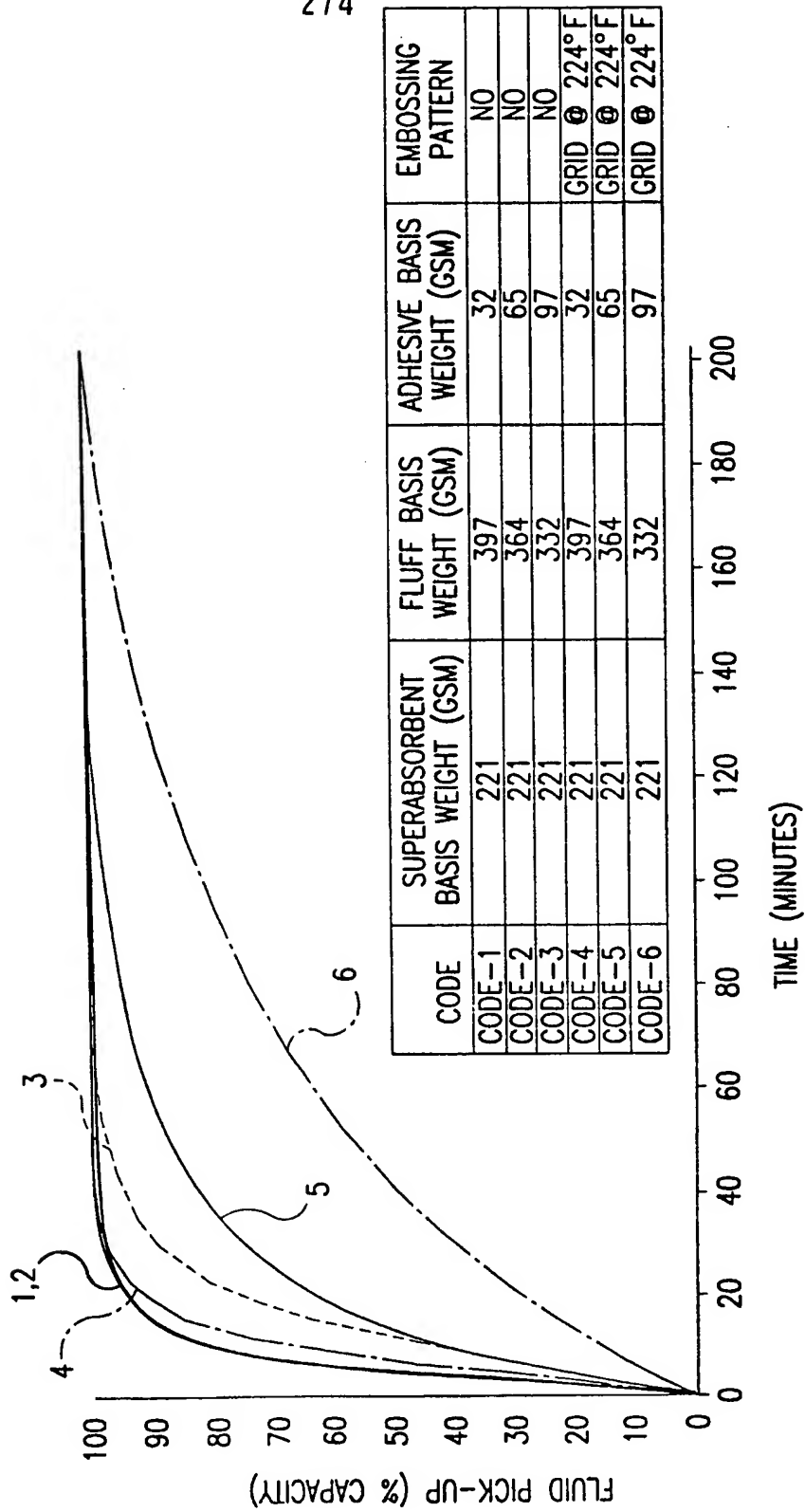


FIG. 6

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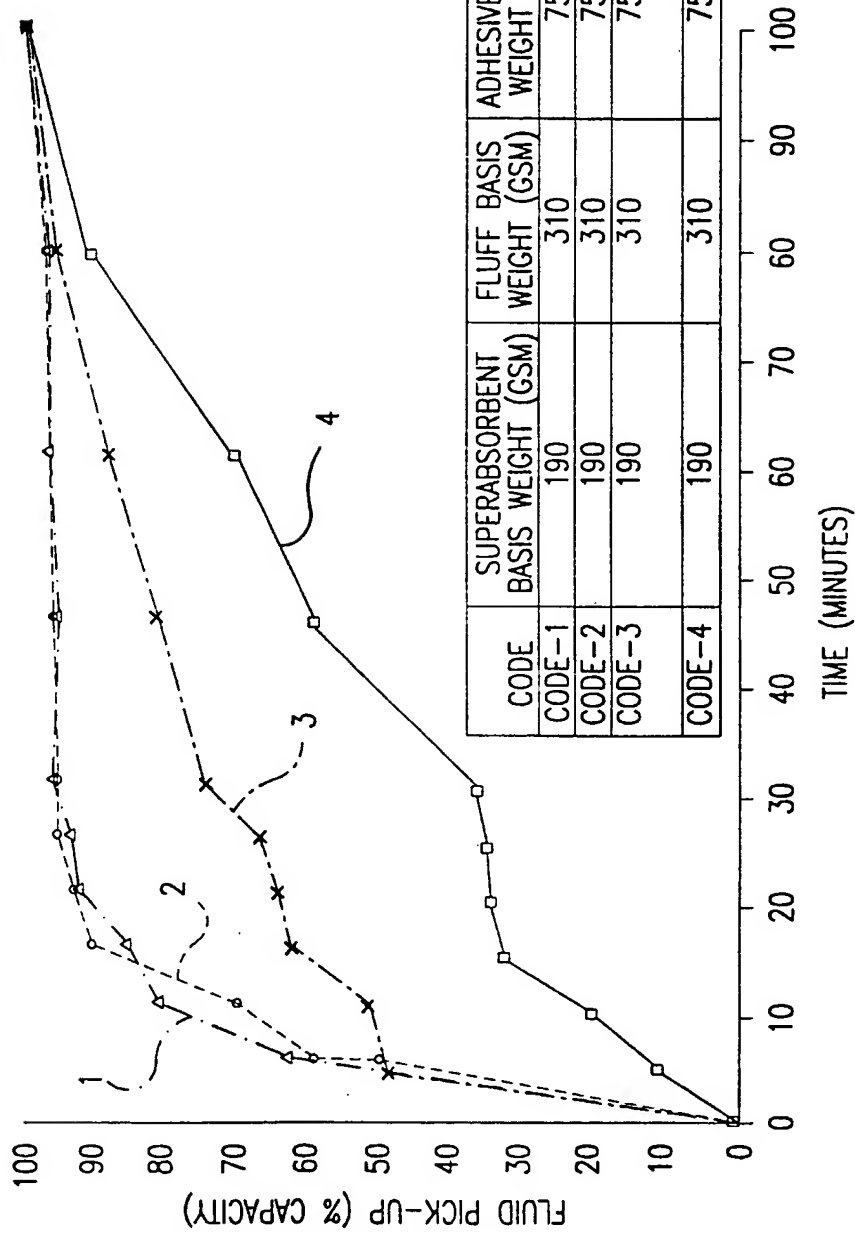


FIG.7

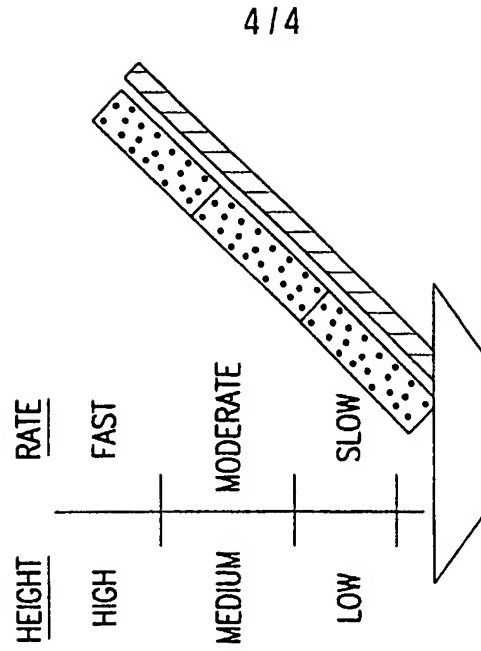


FIG. 9

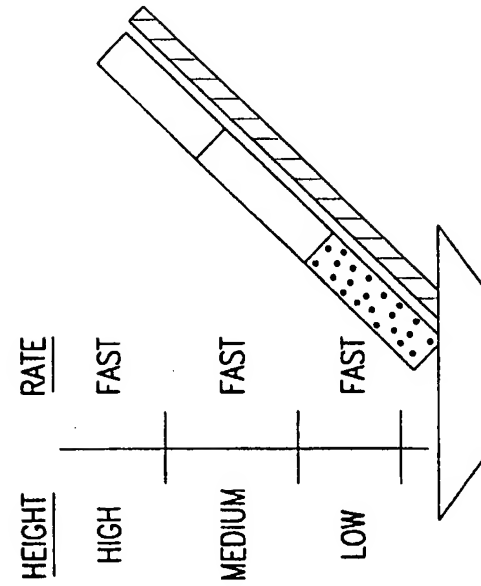


FIG. 8

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 98/22183

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A61F13/15

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 272 916 A (MOELNLYCKE AB) 1 June 1994 see page 7, line 33 - line 38; claims; figures 10,11	1-46
A	WO 91 10413 A (WEYERHAEUSER CO) 25 July 1991 see page 3, line 8 - line 20 see page 6, line 1 - line 16 see page 11, line 19 - line 35 see page 18, line 10 - page 22, line 1; claims; figures 2,3 -/--	1-46

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

4 February 1999

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Mirza, A

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/22183

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>EP 0 633 009 A (CHISSO CORP) 11 January 1995</p> <p>see page 9, line 12 - line 16; table 1 see page 2, line 53 - line 57 ---</p>	<p>1-8,10, 24-27, 29, 38-41, 43,44</p>
A	<p>WO 90 05808 A (SCA PULP AB) 31 May 1990</p> <p>see claims ---</p>	<p>1,8,10, 11,24, 29,30, 38,39,42</p>
A	<p>EP 0 518 291 A (MCNEIL PPC INC) 16 December 1992</p> <p>see column 6, line 40 - column 7, line 2; claims; figures ---</p>	<p>1-4,8, 10,14, 24-27, 29,33, 38-40,43</p>
A	<p>US 5 641 441 A (YANG CHING-YUN M) 24 June 1997</p> <p>see claims ---</p>	<p>1,8,14, 24,27, 33,38, 43,45</p>
A	<p>GB 2 284 551 A (KIMBERLY CLARK CO) 14 June 1995</p> <p>see page 11, line 4 - page 14, line 2; table 1 see page 15, line 13 - page 16, line 2 ---</p>	<p>1-8,10, 11, 15-21, 24-27, 29,30, 34-36, 38-44,46</p>
A	<p>EP 0 202 472 A (GRAIN PROCESSING CORP) 26 November 1986</p> <p>see claims; figures; examples -----</p>	<p>1-8, 23-27, 38,40, 41,43</p>

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/US 98/22183

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2272916 A	01-06-1994	SE 508961 C	23-11-1998
		AU 674041 B	05-12-1996
		AU 5535994 A	08-06-1994
		AU 5580794 A	08-06-1994
		AU 5580894 A	08-06-1994
		AU 677804 B	08-05-1997
		AU 5580994 A	08-06-1994
		CA 2149028 A	26-05-1994
		CZ 9501223 A	17-01-1996
		CZ 9501249 A	18-10-1995
		CZ 9501278 A	18-10-1995
		CZ 9501285 A	18-10-1995
		EP 0773764 A	21-05-1997
		EP 0773766 A	21-05-1997
		EP 0773767 A	21-05-1997
		EP 0773768 A	21-05-1997
		FI 952407 A	17-05-1995
		FI 952408 A	17-05-1995
		FI 952410 A	17-05-1995
		FI 952411 A	17-05-1995
		HU 71657 A	29-01-1996
		HU 71662 A	29-01-1996
		HU 72386 A	29-04-1996
		HU 72249 A	29-04-1996
		JP 8503393 T	16-04-1996
		JP 8503394 T	16-04-1996
		JP 8503395 T	16-04-1996
		JP 8503396 T	16-04-1996
		NO 951893 A	12-05-1995
		NO 951894 A	12-05-1995
		NO 951915 A	15-05-1995
		NO 951931 A	16-05-1995
		NZ 257926 A	25-09-1996
		NZ 258251 A	28-10-1996
		NZ 258252 A	28-10-1996
		NZ 258253 A	28-10-1996
		PL 309006 A	18-09-1995
		PL 309007 A	18-09-1995
		PL 309008 A	18-09-1995
		PL 309035 A	18-09-1995
		SE 9203445 A	18-05-1994
		WO 9410953 A	26-05-1994
		WO 9410954 A	26-05-1994
		WO 9410955 A	26-05-1994
		WO 9410956 A	26-05-1994
		SK 64295 A	08-11-1995
		SK 64995 A	05-02-1997
		SK 65195 A	08-11-1995
		SK 65395 A	08-11-1995
		US 5814034 A	29-09-1998
WO 9110413 A	25-07-1991	US 5188624 A	23-02-1993
		AU 7169591 A	05-08-1991
EP 0633009 A	11-01-1995	JP 7024006 A	27-01-1995
		BR 9402652 A	04-04-1995
		CN 1102976 A	31-05-1995

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/US 98/22183

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9005808 A	31-05-1990	SE 462622 B	30-07-1990
		AU 626941 B	13-08-1992
		AU 4516289 A	12-06-1990
		CA 2003087 A	17-05-1990
		DK 90691 A	25-06-1991
		EP 0444073 A	04-09-1991
		FI 96891 B	31-05-1996
		JP 2628391 B	09-07-1997
		JP 4506234 T	29-10-1992
		SE 8804162 A	17-11-1988
		US 5262005 A	16-11-1993
EP 0518291 A	16-12-1992	AT 156693 T	15-08-1997
		AU 660979 B	13-07-1995
		AU 1737392 A	17-12-1992
		CA 2065220 A	12-12-1992
		DE 69221544 D	18-09-1997
		DE 69221544 T	19-02-1998
US 5641441 A	24-06-1997	US 5525407 A	11-06-1996
		AT 166116 T	15-05-1998
		BR 9500002 A	19-09-1995
		CA 2139382 A	04-07-1995
		DE 69502413 D	18-06-1998
		DE 69502413 T	04-02-1999
		EP 0666350 A	09-08-1995
		ES 2115987 T	01-07-1998
		JP 8224815 A	03-09-1996
		US 5589117 A	31-12-1996
GB 2284551 A	14-06-1995	AU 1049795 A	13-06-1995
		CA 2136471 A	24-05-1995
		EP 0730438 A	11-09-1996
		FR 2712801 A	02-06-1995
		JP 9505495 T	03-06-1997
		WO 9514452 A	01-06-1995
		ZA 9409297 A	12-01-1996
EP 0202472 A	26-11-1986	DK 182786 A	23-10-1986
		FI 861594 A	23-10-1986